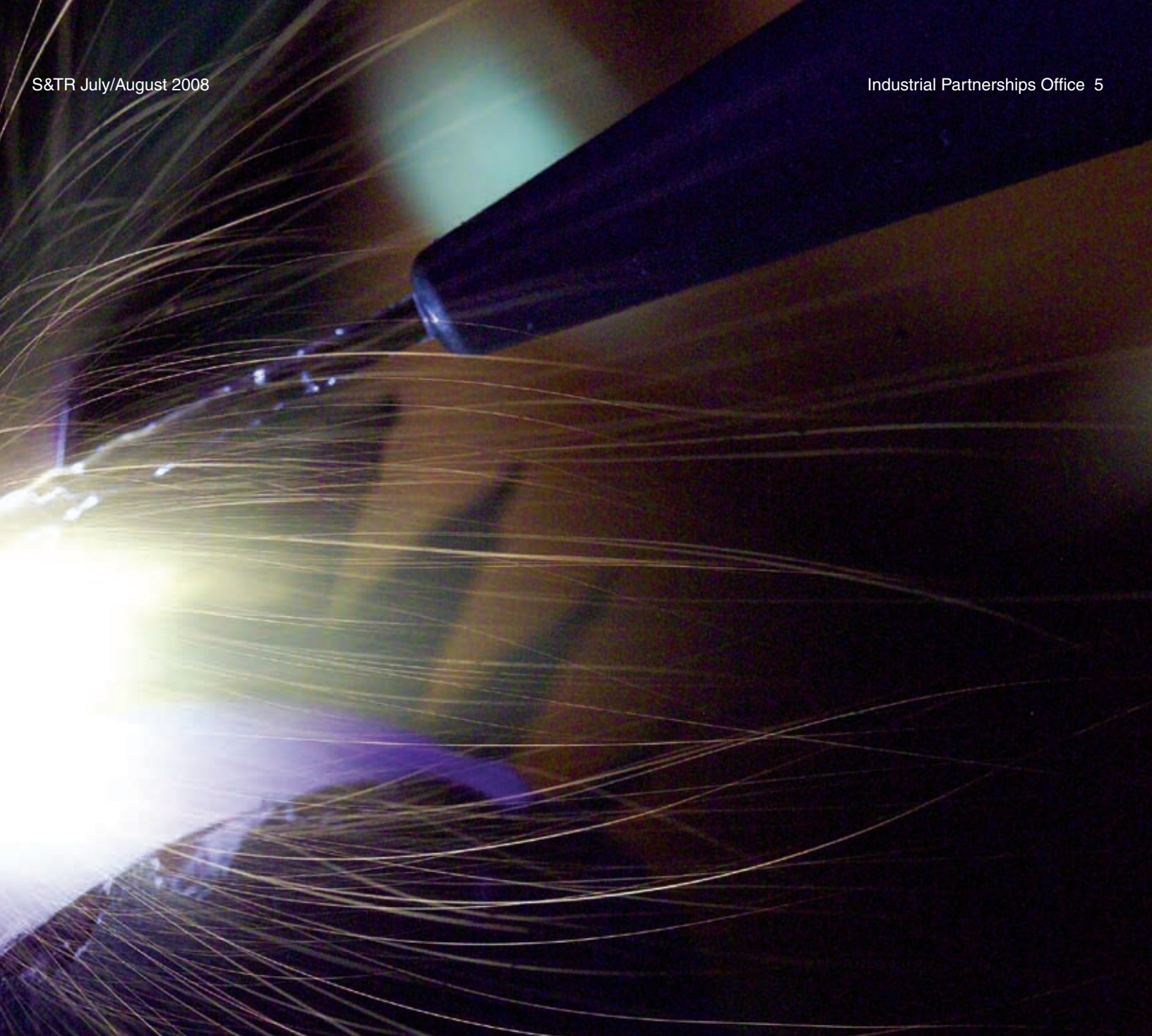
The New Face of Industrial Partnerships

Livermore's Industrial Partnerships Office has a new name, a new director, and ambitious new goals.

Livermore's Industrial Partnerships Office (IPO) helps the Laboratory transfer innovative inventions to the private sector. For example, laser peening (above), a spin-off technology from Livermore's laser research, can be used to increase the strength of welds in critical metal parts. (Image courtesy of Metal Improvement Company.)



THE director of Livermore's Industrial Partnerships Office (IPO) posted a brief notice one day last March for a series of lectures he planned to give in April on "Developing Business Models for Emerging Technologies." Attendance was to be limited to 30 individuals. Forty people inquired within a day, and 60 scientists, engineers, and other employees from across the Laboratory came to listen and learn.

Lawrence Livermore has been a leader for many years among Department of Energy (DOE) laboratories in licensing and commercializing the technologies it develops. But IPO Director Erik Stenehjem (pronounced sten-yem) and his staff have big plans to significantly expand business activities with private firms and nonfederal entities, including doubling over the next five years the number of commercial licenses.

Stenehjem came to Livermore from Pacific Northwest National Laboratory and its managing organization Battelle as part of the public–private consortium that now operates Lawrence Livermore National Laboratory. (See the box on p. 10.) At Pacific Northwest, Stenehjem managed new ventures and regional initiatives. Battelle is a national leader in commercializing technologies.

Stenehjem has only good things to say about the staff at IPO (formerly called Industrial Partnerships and Commercialization). Among the seven business development executives and the

management team, six individuals have a Ph.D. in science or engineering, five are attorneys, three have experience in startup companies, and four are registered patent attorneys. Some staff members wear more than one of these hats. Over the last several years, the capable staff has successfully commercialized dozens of Livermore technologies for homeland security, health care, manufacturing, and more. "It's a highly talented group," says Stenehjem. "Last year, they returned more than $6 million in royalties to the Laboratory. Combined with the industry funding from cooperative agreements, that yielded almost $3 for every dollar spent by the office."

Why Partner?

Since the Laboratory's founding in 1952, its mission has been to ensure national security and find science and technology solutions to our nation's problems. Partnering with industry brings the additional expertise needed to accomplish the Laboratory's mission. At the same time, many private companies that have licensed and commercialized Livermore technologies are achieving great success.

Supercomputing is an excellent example of how collaborations with industry have served Livermore's goals. To model the behavior of nuclear weapon materials and components in computer simulations, Livermore researchers have created a virtually insatiable demand for computing power. That demand drove the design of the first supercomputers and led to partnerships with IBM, Control Data Corporation, and Cray, among many others. Under the National Nuclear Security Administration's Advanced Simulation and Computing Program, partnerships with IBM have led to the development of many breakthrough machines, including the Blue Gene line of supercomputers. BlueGene/L, Livermore's largest computing resource, is helping researchers perform both classified and unclassified research.

Collaborations with private industry have also been crucial in developing the Laboratory's record-shattering lasers over the last four decades. For the National Ignition Facility, the world's largest laser, Livermore scientists and dozens of private firms came together to develop new tools, materials, and manufacturing methods. Many of the components in the laser system represent significant advancements of current technologies,

The IPO staff is key to Lawrence Livermore successfully licensing and commercializing its technologies.

while other components are entirely new. Commissioning of the giant laser will be complete in 2009, and experiments to achieve fusion ignition will begin in 2010.

Meanwhile, dozens of Livermore innovations have moved to the private sector. One is a laser process to strengthen metal components, making them better able to resist fatigue and corrosion. Metal Improvement Company (MIC) of Paramus, New Jersey, a firm specializing in metal treatments, licensed this Laboratory invention and continues to refine the process. Robotic laser peening is now routinely used to strengthen and form critical components of aircraft engines for longer life. MIC recently received a contract to establish a laser-peening production cell inside Boeing Corporation's Frederickson, Washington, facility. MIC's innovations also improve fatigue lifetime for components of the Apache and Blackhawk helicopters, the M1A1 Abrams tank, the F-22 fighter jet, and the B-52 bomber.

For the Laboratory's mission in homeland and global security, success depends on commercializing inventions and getting a usable product, such as a new radiation or biological-agent detector, into the hands of end users as quickly as possible. Transferring Livermore-developed technologies to the private sector makes these advances available to those who secure our borders and airports, monitor public places for biological or chemical attacks, and respond to emergencies. Working directly with private organizations helps speed the delivery of new inventions to users. IPO plays an important role in identifying and wooing industrial partners as well as in simplifying the process by which the Laboratory works with other entities. "We're exploring ways to make the contracting process faster and easier," says Stenehjem.

One technology important for homeland security is an ultrawideband (UWB) device that can monitor cargo containers and detect unauthorized entry. Every year,

Collaborations with private industry have been important for the National Ignition Facility (NIF). For example, NIF worked with Hoya Corporation and Schott Glass Technologies, Inc., to develop a production method that continuously melts and pours the glass needed to amplify the laser light for experiments. Shown here, an employee at Hoya inspects a sheet of glass as it moves down the assembly line.

A partnership between Livermore and IBM led to the development of BlueGene/L, one of the most capable computing machine in the world. The unusual slant to the BlueGene/L cabinets is a necessary design element to keep cooled air flowing properly around each cabinet's 2,000-plus processors.

more than 200 million shipments transport 90 percent of the world's cargo on trains, airplanes, ships, and trucks. Concern about a terrorist organization using a cargo container to deliver a weapon of mass destruction into the U.S. led to the development of an inexpensive, reliable, and reusable detection device called SecureBox.

The device uses UWB technology first developed at Livermore in the early 1990s with funding from the Laboratory Directed Research and Development (LDRD) Program. Modern UWB technology at Livermore uses coherent, broad-spectrum, low-power pulses, which allow devices to be highly sensitive to intrusions into a preset area of coverage while consuming considerably less power than a narrowband device with comparable sensitivity. The SecureBox UWB device can detect an intrusion through any of a container's six walls, whether it be from a door opening or from a cut through a container wall. It can then send an alarm to authorized individuals.

The Secure Box Corporation of Santa Clara, California, licensed the technology and subsequently invested $500,000 in a Cooperative Research and Development Agreement (CRADA) with Livermore to customize the core technology for the cargo security application and to explore uses for the SecureBox device by the U.S. government. The device's efficacy was demonstrated by the Laboratory during the 2006 Canada–U.S. Cargo Security Project, Phase 2. More recently, the technology has been tested in exercises in Europe and the San Francisco Bay Area and with the U.S. Coast Guard.

Innovation Breeds Success

Another Laboratory-inspired venture may radically improve the way cancer patients receive treatment. Last year, a private firm licensed an accelerator technology that Livermore first explored with LDRD funding to take x-ray images deep inside nuclear weapon surrogates during nonnuclear testing. A Livermore colleague working in another program saw the accelerator concept and suspected it could be used for proton therapy, a radiation treatment that can zap tumors with a powerful, focused beam while causing minimal damage to surrounding healthy tissue. This idea led to yet another LDRD project, one that would explore the technology for building small proton accelerators that could be used in cancer radiation therapy. In 2004, the University of California (UC) Davis Cancer Center began partnering with the Laboratory on this project and matched the LDRD investment.

Radiation from traditional x- and gamma-ray treatments often damages healthy tissue as it travels on its path to the target tumor. Protons, because of their positive charge and high mass, retain most of their energy until they reach the cancer site. Many doctors consider protons to be superior to x rays for treating certain kinds of cancers. However, current proton accelerators are expensive machines that weigh several hundred tons and are the size of a basketball court. Only about half a dozen cancer treatment centers in the U.S. have systems for proton therapy. When Livermore's device is fully developed, it will be just 2 meters long and deliver the necessary beam energy at a fraction of the cost of current systems.

SecureBox is a wireless device that can be installed on cargo containers to detect intrusions.

Researchers at the UC Davis Cancer Center acted as matchmaker for licensing the accelerator technology. UC Davis had purchased another type of radiation therapy machine from TomoTherapy, Inc., of Madison, Wisconsin, a firm specializing in radiation treatment for cancer. In 2005, UC Davis invited Livermore scientists to

present their technology to TomoTherapy. In 2006, UC Davis signed a second partnership agreement with the Laboratory to further develop the accelerator for cancer therapy.

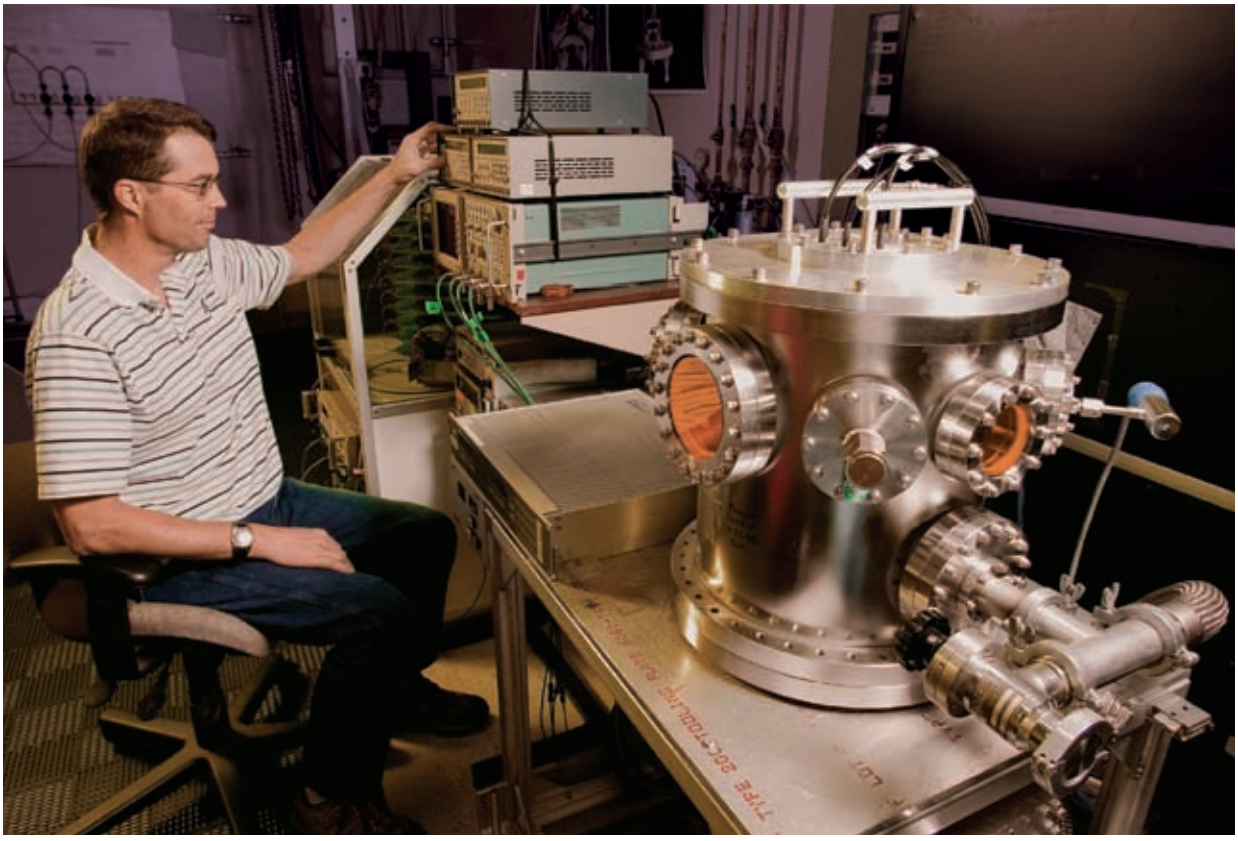
Meanwhile, IPO business development executive Genaro Mempin was negotiating with TomoTherapy and other interested companies. "After more than a year, TomoTherapy licensed the technology in February 2007," says Mempin. TomoTherapy is contributing funding to Livermore through a CRADA and now works with both UC Davis and the Laboratory to develop a prototype, which will be tested at UC Davis.

Physicist George Caporaso, who led the team that originally explored the accelerator concept for defense-related use, is thrilled to see this new application. "The idea to use the accelerator for cancer treatment came from Dennis Matthews [now at UC Davis Cancer Center]," says Caporaso. "I would never have thought of it, and it may well revolutionize cancer treatment." TomoTherapy has four employees at the Laboratory, working alongside their technical counterparts. Caporaso leads the collaboration with UC Davis and TomoTherapy.

Crossing the Valley of Death

Stenehjem and his team are taking an aggressive approach to vaulting inventions across the "Valley of Death," the funding gap that typically exists between a laboratory invention and a marketable prototype. The technologies developed at institutions such as Livermore are highly effective at doing what they are designed to do, but they may be unsuitable outside a research environment and difficult to operate without training. Or, as with the compact accelerator, the invention may be targeted at a market totally different from that for which it was conceived. The Laboratory typically cannot pay to develop the commercial version of its invention. Yet, venture capitalists and private companies are inclined to invest only in technologies or products that are proven and ready for use.

At Livermore, every IPO business development executive keeps tabs on competing patents and other intellectual property for a particular area of Laboratory research. He or she also follows relevant markets and private companies that might be interested in a new invention. In addition, Livermore-developed technologies are posted on the *Federal Business Opportunities* Web site. However, these efforts may not be enough to attract



James Watson sets up a test stand for ion-source development, one component of the compact proton accelerator designed for cancer therapy.

either venture capital or a company to license a technology, in which case the Valley of Death looms ahead.

Livermore and UC Davis were so convinced of the potential for the small accelerator as a cancer therapy tool that the two institutions invested in it, avoiding the Valley of Death. Livermore's IPO and its counterpart at UC Davis each invested $1.5 million to ready the technology for the marketplace, a process called technology maturation. Their continued efforts on the device helped make it more marketable, enough so that TomoTherapy was willing to invest in the collaboration.

Business Plans Are Win-Win

One way to help leapfrog the Valley of Death to successful commercialization is to develop a solid business plan. Few funding organizations will consider investing in a new technology that does not have well-researched numbers on the technology's viability in the marketplace, its competition, proposed company management, pricing, and details of required funding. Most Laboratory researchers are not business planning experts, so IPO is working with graduate-student scientists and engineers who are in programs on entrepreneurship at several nearby universities. These students draw up business plans for Livermore technologies.

School-sponsored competitions for student-written business plans award as much as $250,000 to the winner. Students want to prepare a winning business plan, yet they often have to dream up a product or technology to write about. The increased prize money and popularity of the contests has led student teams to seek compelling high-tech products as subjects for their business plans. If a student writes a business plan for a Livermore technology, he or she may win the competition, and the Laboratory gets a business plan it can take to venture capitalists. Everyone wins.

Livermore has had some success in the past with student-written business plans. However, Stenehjem is being more aggressive with this tool, on the assumption that more business plans will translate into a higher number of technologies licensed by well-financed companies. Last year, Stenehjem tapped physicist Ralph Jacobs to establish an outreach program to area business schools. Jacobs has extensive laser science experience at the Laboratory and started a successful firm in California's Silicon Valley, where he worked in the 1980s. The company was purchased in 2000 for what was then the largest takeover offer for a high-tech company.

Stenehjem, Jacobs, and others sifted through more than 900 Livermore patents to find ones that represented a "disruptive" or revolutionary technology, could be commercialized in about two years, and were unencumbered by other licenses or CRADAs. "Some patents involved only

New Director of the Industrial Partnerships Office

Erik Stenehjem, with a Ph.D. in economics, brings to Livermore an impressive record of successful technology transfer and entrepreneurship. At Pacific Northwest National Laboratory (PNNL), he was responsible for creating new technology-based ventures and building partnerships with institutions in the Pacific Northwest, a job similar to his position at Livermore. At PNNL, he worked with regional research institutions, including universities in Washington and Oregon, to find and bundle technologies and pair them with economic activity within the region. PNNL is in rural southeastern Washington, far from major urban centers. He had to reach out—far out, in many instances—to take new technologies into the marketplace.

Erik Stenehjem joined the Laboratory in 2007 to lead the Industrial Partnerships Office.

In 2006, the State of Oregon appointed Stenehjem to serve as science and technology advisor to Governor Ted Kulongoski. He also served on the Washington Economic Development Commission's steering committee for technology commercialization and the board of advisors for the University of Washington's Center for Innovation and Entrepreneurship. At both the University of Washington and Washington State University, Stenehjem taught courses on entrepreneurship and new business creation in masters in business administration programs. He led students into business plan competitions, with the goal of developing new businesses to enhance the Washington state economy.

Before joining Battelle, which manages PNNL, he founded his own business in the early 1980s. He assisted clients in forecasting and mitigating the effects of rapid economic growth and decline on regional economies. Stenehjem not only talks the talk, but on his own, he has walked the walk.

an incremental change to an existing device or process," says Jacobs, "while others were too futuristic." Ultimately, the reviewers selected 17 standout technologies, including a residential solar thermal power plant, a method to generate electricity from waste heat, electromechanical batteries, nanolaminate capacitors, nanolaminate mirrors, and a water treatment process using carbon nanotubes.

The 17 technologies were advertised on IPO's Web site (ipo.llnl.gov) and by Jacobs and Stenehjem during visits to classes on entrepreneurship at nearby business schools. Several business schools signed on, including UC Davis, UC Berkeley, University of San Francisco, Golden Gate University, San Jose State University, and University of the Pacific. Jacobs says, "A student at Sloan School of Management at the Massachusetts Institute of Technology found us while surfing the Web. He also developed a plan."

Students in masters of business administration programs completed business plans for 12 Livermore technologies, and many were entered in competitions. Three made it to the finals of various contests. The outlook for funding and commercializing these technologies indeed looks bright.

Funding is the magic word. Any new business requires four ingredients: technology, management, knowledge of the market, and money. "You need the right combination of all four pieces," says Stenehjem. "The Laboratory has the technology, and some scientists and engineers make good managers. The students' business plans provide the market knowledge. That leaves money."

Livermore is developing a close relationship with venture capitalists and "angel investors," which are consortia of wealthy individuals. For example, Laboratory technology transfer representatives have been invited to attend monthly meetings of Keiretsu Forum, the world's largest angel investor network with 750 accredited investor members on three continents.

Having newly minted business plans in place will give Livermore a leg up with investors. "Venture capitalists judge business plan competitions," says Stenehjem, "and they love cutting-edge technologies."

Into the Future

Funding more commercial ventures and startup companies based on Livermore technologies will increase royalties to the Laboratory. Most licensing and royalty income is distributed back to the Laboratory directorates, with much of the remainder going to the inventors. A small amount goes to the institution for administrative costs, readying technologies for the marketplace, and other technology-transfer activities. Toward this end, Stenehjem hopes to hire more business development executives and patent attorneys and further increase patent protection and IPO's production level.

He has broadened the responsibilities of IPO's business development executives. Feedback from commercial partners indicates that they are often unaware of all the Laboratory has to offer. Partners work with a principal investigator and perhaps a few more scientists and engineers, but the rest of the Laboratory remains unknown to them. Business development executives can inform partner firms of other licensing and contracting opportunities at Livermore. Also, by serving as a central point of contact for partner firms, the IPO executives can address issues and concerns before they become problems.

Looking further into the future, Stenehjem envisions a technology research park outside the Laboratory's gates where scientists and engineers could more easily engage with industrial partners and develop new commercial ventures. He also hopes to explore interest in an "accelerator" that would bring together venture capitalists; serial entrepreneurs, who start a business and move on to another; market analysts; and Livermore technologies. Stenehjem's enthusiasm is palpable. When he says, "These are exciting times," he means it.

—Katie Walter

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